

## CONCEPTUAL DESIGN TOOL

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention generally relates to a computer based project management system and, more particularly, to a system which uses a top down functional approach to hardware product design which involves creating and exploiting a hierarchical tree view of the product structure early in the design process.

#### 2. Description of the Prior Art

The process of designing, developing and manufacturing a new product, or making major changes to existing products, presents many challenges to product managers and engineers to bring the product to market for the least cost, within schedule while maintaining product quality. In today's highly competitive industries, product managers and engineers require information to address many problems that arise because of the complexity of new products and the complexity of worldwide production and the changing nature of competition. Because new products need to be brought to market in a very short time period to meet the competition, the traditional learning curve formerly associated with product development has disappeared, creating the need to better control product release and determine cost impacts of designs early in the design process.

To meet these needs, many companies are realizing that the conventional product design process is not satisfactory. They require early involvement of manufacturing engineering, cost engineering, logistics planning, procurement, manufacturing and service/support with the design effort. In addition, they require planning and control of product data through design, release and manufacturing.

Project Management, as a modern management tool, has its origins in the early part of this century when Henry L. Gantt, while working for the government during World War I, developed his now famous visual aid for work control. The Gantt chart is a graphic representation of a project schedule that shows each task as a bar having a length proportional to the duration of the task. Later during the 1950s, Dr. John Presper Mauchley, a co-inventor of the EDVAC at the University of Pennsylvania, developed the Critical Path Method (CPM) which was further developed by Willard Frazer, a consultant on the Polaris submarine project. Frazer's contribution was called Program Evaluation and Review Technique (PERT). A PERT chart is one that resembles a flow chart showing predecessor and successor tasks of a project and the critical path.

PERT/CPM models are known and have been used for many years by many large corporations for project management. Such project management tools were first implemented on main frame computers and then on mini computers, equipment which was readily available to large corporations but not to small corporations and firms. More recently, various project management software products have been developed for micro or so-called personal computers. These have made computer based project management tools more economically accessible to small corporations and firms, but their application requires some degree of sophistication on the part of the user. As a result, many small corporations and firms still use manual methods of project management, often relying on an expeditor to stay one step

ahead in scheduling supplies and work on a day to day basis.

Rupert A. Schmidtberg and Mark A. Yerry in an article entitled "Designing Complex Assemblies Using the Top-Down Approach" published in *Autofact* 1986 *Proceedings*, at pages 9-31 to 9-43, describe a design approach where the engineer first creates the top-most assembly and works downward, filling in of the subordinate subassemblies and parts. In this approach, a hierarchical representation of the design object is built and refined. As a design concept is refined, design constraints are communicated down the hierarchy. Evaluation of the design concept at each level of refinement may cause feedback to be passed up the hierarchy in the form of recommendations for design changes or requests to relax some design constraints.

This top-down design approach has significant advantages over the traditional approach to design of a new product. The Schmidtberg and Yerry implementation, however, is in the environment of a CAD/CAE system which assumes a high degree of computer design sophistication on the part of the user. What is needed is a simpler to use system which takes advantage of the top-down design approach.

### SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide an easy to use system which implements a top-down functional approach to hardware product design.

It is another object of the invention to provide a system which integrates a top-down design approach and prompts the new product designer by a graphic display of the product components.

According to the invention, a sketch sheet approach on a computer display is used to enter the functional design of a product. The user needs to key in only part descriptions, and the system automatically draws a hierarchical tree structure on the computer display. The user is then prompted to consider, part by part, all of the parts in the product. A series of menus pop-up and guide the user through manufacturing planning for that part.

The process begins by producing a functional sketch of the product design. This sketch is in the form of a hierarchical tree structure, thereby encouraging the top-down design approach. The system queries the user for component parts of the product, and as the query process progresses, the tree structure is created on the computer screen for the user to view.

Behind each element, or item, in the functional hierarchy of the product, associated engineering design and manufacturing information is gathered. This manufacturing detail is used for product release planning and scheduling, and manufacturing planning, as well as for feasibility level cost estimating. The user has the option at any time during the design process to deal with the proposed product or product components at a high level or at a very detailed level. At any level, manufacturing details which are not known by the user can be defaulted from a relational database using the known item attributes.

The product designer is aided in implementing early manufacturing involvement, or the integration of the design process with manufacturing and other production-related concerns. The designer is prompted to enter manufacturing data for each item in the product structure, thus introducing a third dimension to the hierarchical tree structure. This third dimension serves